

State of California
The Resources Agency
Department of Fish and Game

**RECOVERY STRATEGY FOR
CALIFORNIA COHO SALMON**
Report to the California Fish and
Game Commission

Prepared by
The California Department of Fish and Game

Species Recovery Plan Report 2003-1

August 2003

Table of Contents

1	Introduction	1-1
1.1	STATE OF CALIFORNIA COHO SALMON LISTING ACTIONS	1-1
1.2	FEDERAL COHO SALMON LISTING ACTIONS	1-2
1.3	STRATEGIC PLANNING FOR RECOVERY	1-3
1.3.1	FISH AND GAME COMMISSION ACTION	1-3
1.3.2	CALIFORNIA STATEWIDE RECOVERY TEAM	1-3
1.3.3	SHASTA-SCOTT RIVER RECOVERY TEAM	1-4
1.3.4	FEDERAL TECHNICAL REVIEW TEAMS	1-4
1.4	RECOVERY STRATEGY FOR COHO SALMON IN CALIFORNIA	1-5
1.4.1	GENERAL GOALS	1-5
1.4.2	ELEMENTS NECESSARY TO ACHIEVE RECOVERY GOALS	1-6
1.4.3	IMPLEMENTATION	1-7
1.4.3.1	Immediate Actions	1-7
1.4.3.2	Longer Term Actions	1-7
1.4.4	ADAPTIVE MANAGEMENT	1-7
2	Biology	2-1
2.1	RANGE	2-1
2.2	EVOLUTIONARILY SIGNIFICANT UNITS	2-2
2.2.1	SOUTHERN OREGON/NORTHERN CALIFORNIA COAST COHO ESU	2-5
2.2.2	CENTRAL CALIFORNIA COAST COHO ESU	2-5
2.3	LIFE HISTORY	2-6
2.4	POPULATION STRUCTURE AND VIABILITY	2-8
2.4.1	POPULATION STRUCTURE	2-9
2.4.2	POPULATION VIABILITY	2-10
2.5	GENETICS	2-11
2.6	HABITAT REQUIREMENTS	2-17
2.6.1	HABITAT REQUIREMENTS FOR ADULTS.....	2-17
2.6.1.1	Migration	2-17
2.6.1.2	Spawning	2-18
2.6.2	HABITAT REQUIREMENTS FOR JUVENILES	2-19
2.6.2.1	Eggs and Alevin Incubation.....	2-19
2.6.2.2	Fry Emergence	2-20
2.6.2.3	Juvenile Rearing	2-20
2.6.2.4	Emigration.....	2-21

2.6.3	ESSENTIAL ESTUARINE HABITAT	2-22
2.6.4	SUMMARY OF ESSENTIAL HABITAT	2-22
2.6.4.1	Stream Vegetation	2-23
2.6.4.2	Large Woody Debris	2-23
2.6.4.3	Sediment and Substrate	2-25
2.6.4.4	Hydrological Regime	2-25
2.6.4.5	Water Temperature	2-25
2.6.4.6	Dissolved Oxygen	2-26
3	Threats	3-1
3.1	CLIMATIC VARIATION	3-1
3.1.1	DROUGHT	3-1
3.1.2	FLOODING	3-2
3.1.3	OCEAN CONDITIONS	3-2
3.2	DISEASE	3-4
3.3	PREDATION	3-4
3.3.1	FRESHWATER PREDATION	3-4
3.3.2	MARINE PREDATION	3-5
3.4	HATCHERIES	3-6
3.5	GENETIC DIVERSITY	3-6
3.6	LAND USE	3-10
3.6.1	FORESTRY ACTIVITIES	3-10
3.6.2	WATER DIVERSIONS AND FISH SCREENS	3-11
3.6.3	INSTREAM FLOWS	3-13
3.6.4	ARTIFICIAL BARRIERS	3-14
3.6.5	GRAVEL EXTRACTION	3-16
3.6.6	SUCTION DREDGING	3-17
3.6.7	STREAMBED ALTERATION	3-17
3.6.8	WATER QUALITY	3-17
3.6.9	AGRICULTURAL IMPACTS	3-20
3.6.10	URBANIZATION	3-21
3.6.11	FISHING	3-21
3.6.12	ILLEGAL HARVEST	3-22
4	Recovery Goals and Delisting Criteria	4-1
4.1	FRAMEWORK FOR DELISTING CRITERIA	4-1
4.2	DELISTING REQUIREMENTS	4-3
4.2	FRAMEWORK FOR RESTORATION OF FISHERIES	4-8
4.2.1	RECREATIONAL FISHING	4-9
4.2.2	COMMERCIAL FISHING	4-10

5	Elements Necessary for Recovery.....	5-1
5.1	ROLE OF PUBLIC LANDS	5-1
5.1.1	FEDERAL LANDS	5-1
5.1.1.1	U.S. Forest Service (USFS)	5-2
5.1.1.2	U.S. Bureau of Land Management (BLM)	5-2
5.1.1.3	U.S. National Park Service (NPS)	5-7
5.1.1.4	U.S. Department of Defense (DOD)	5-7
5.1.1.5	U.S. Fish & Wildlife Service (USFWS)	5-7
5.1.1.6	U.S. Bureau of Reclamation (BOR)	5-8
5.1.2	STATE LANDS	5-8
5.1.2	STATE LANDS	5-8
5.1.2.1	California Department of Parks and Recreation (DPR).....	5-8
5.1.2.2	California Department of Forestry and Fire Protection (CDF).....	5-8
5.1.2.3	California State Lands Commission (SLC)	5-9
5.1.2.4	California Department of Fish and Game	5-9
5.1.3	COUNTY AND CITY LANDS	5-10
5.2	PRIVATE AND PUBLIC COOPERATION	5-10
5.2.1	EXISTING PROGRAMS	5-10
5.2.1.1	Fisheries Restoration Grants Program	5-10
5.2.1.2	Farm Bill Grants	5-12
5.2.1.3	Watershed and Nonpoint Source Pollution Control Programs	5-13
5.2.1.4	Other Programs	5-15
5.2.2	MINIMIZING SOCIAL AND ECONOMIC IMPACTS.....	5-15
5.2.3	VOLUNTARY INCENTIVES	5-15
5.3	OUTREACH AND EDUCATION	5-15
5.3.1	RECOVERY STRATEGY RECOMMENDATIONS	5-16
5.3.2	EDUCATION AND OUTREACH PLAN	5-16
5.3.2.1	School Curricula	5-16
5.3.2.2	Interpretive Media	5-17
5.4	ASSESSMENT, MONITORING, AND RESEARCH	5-18
5.4.1	PROGRAM FRAMEWORK	5-18
5.4.1.1	Scientific Planning and Prioritization	5-18
5.4.1.2	Evaluating Current Monitoring	5-19
5.4.1.3	Data Management	5-19
5.4.1.4	New Research	5-21
5.4.1.5	Program Reporting	5-21
5.4.2	ASSESSMENT	5-21
5.4.3	MONITORING	5-22
5.4.3.1	Three-tiered Monitoring Framework	5-22
5.4.3.2	Monitoring of the Coho Salmon Monitoring Program	5-24
5.4.4	NEW RESEARCH	5-25
5.4.5	COLLABORATION AND PROGRAM PERFORMANCE	5-26
5.4.6	ASSESSMENT, MONITORING, AND RESEARCH	5-26

6	Range-wide Recommendations	6-1
6.1	STREAM FLOW	6-1
6.2	WATER RIGHTS	6-2
6.3	FISH PASSAGE	6-3
6.4	POLLUTANTS	6-3
6.5	SEDIMENTS	6-4
6.6	WATER TEMPERATURE	6-4
6.7	RECRUITMENT OF LARGE WOODY DEBRIS	6-5
6.8	STREAM COMPLEXITY	6-5
6.9	ECOLOGICAL REFUGIA	6-5
6.10	HABITAT FRAGMENTATION	6-5
6.11	COMPETITION	6-5
6.12	GENETICS	6-6
6.13	RIPARIAN VEGETATION	6-6
6.14	LAND USE	6-6
6.15	PUBLIC OUTREACH	6-7
6.16	INTEGRATION WITH OTHER PLANS AND PROGRAMS	6-7
6.17	PERMITTING	6-7
6.18	WATERSHED PLANNING	6-8
6.19	ENFORCEMENT OF EXISTING LAWS	6-8
6.20	IMPLEMENTATION	6-9
6.21	INSTREAM GRAVEL MINING	6-10
7	Watershed Recommendations	7-1
7.1	WATERSHED CLASSIFICATION	7-1
7.2	SOUTHERN OREGON/NORTHERN CALIFORNIA COASTS ESU	7-2
7.2.1	ROGUE RIVER AND WINCHUCK RIVER HYDROLOGIC UNITS	7-2
7.2.1.1	Illinois River HSA	7-9
7.2.1.2	Winchuck River Hydrologic Unit / Winchuck River HSA	7-9
7.2.2	SMITH RIVER HYDROLOGIC UNIT	7-10
7.2.2.1	Recommendations for the Smith River HU	7-10
7.2.2.2	Mill Creek HSA	7-11
7.2.2.3	Wilson Creek HSA	7-12
7.2.2.4	Smith River Plain HSA	7-12
7.2.2.5	HSAs with No Recommendations	7-13
7.2.3	KLAMATH RIVER HU	7-13
7.2.3.1	Recommendations for the Klamath River HU	7-14
7.2.3.2	Klamath Glen HSA	7-14
7.2.3.3	Orleans HSA	7-16
7.2.3.4	Ukonom HSA	7-17
7.2.3.5	Happy Camp HSA	7-18
7.2.3.6	Seiad Valley HSA	7-20

- 7.2.3.7 Beaver Creek HSA 7-21
- 7.2.3.8 HSAs with No Recommendations 7-22
- 7.2.4 SALMON RIVER HYDROLOGIC AREA 7-22
 - 7.2.4.1 Recommendations for the Salmon River HA 7-25
 - 7.2.4.2 HSAs with No Recommendations 7-26
- 7.2.5 SHASTA VALLEY AND SCOTT RIVER HYDROLOGIC AREAS 7-26
 - 7.2.5.1 Shasta Valley HA/HSA 7-26
 - 7.2.5.2 Scott River HA 7-29
 - 7.2.5.3 Recommendations for the Scott and Shasta Rivers (Non-agricultural) 7-30
- 7.2.6 TRINITY RIVER HYDROLOGIC UNIT 7-34
 - 7.2.6.1 Trinity River HU Recommendations 7-37
 - 7.2.6.2 Douglas Creek HSA 7-37
 - 7.2.6.3 Grouse Creek HSA 7-38
 - 7.2.6.4 Hyapom HSA 7-38
 - 7.2.6.5 Hayfork HSA 7-38
 - 7.2.6.6 HSAs with No Recommendations 7-39
- 7.2.7 MAD RIVER HYDROLOGIC UNIT 7-40
 - 7.2.7.1 Mad HU Recommendations 7-43
 - 7.2.7.2 Blue Lake HSA and North Fork Mad HSA 7-44
 - 7.2.7.3 HSAs with No Recommendations 7-44
- 7.2.8 REDWOOD CREEK HYDROLOGIC UNIT 7-44
 - 7.2.8.1 Redwood Creek HU Recommendations 7-47
 - 7.2.8.2 HSAs with No Recommendations 7-48
- 7.2.9 TRINIDAD PLAIN HYDROLOGIC UNIT 7-48
 - 7.2.9.1 Trinidad Plain HU Recommendations 7-49
 - 7.2.9.2 Big Lagoon HSA 7-49
 - 7.2.9.3 Little River HSA 7-49
- 7.2.10 EUREKA PLAIN HYDROLOGIC UNIT 7-50
- 7.2.11 EEL RIVER HYDROLOGIC UNIT 7-53
 - 7.2.11.1 Eel River HU Recommendations 7-54
 - 7.2.11.2 Ferndale HSA 7-54
 - 7.2.11.3 South Fork Eel River HSA 7-57
 - 7.2.11.4 Weott HSA 7-57
 - 7.2.11.5 Laytonville HSA 7-58
 - 7.2.11.6 Outlet Creek HSA 7-58
 - 7.2.11.7 HSAs with No Recommendations 7-59
- 7.2.12 CAPE MENDOCINO HYDROLOGIC UNIT 7-62
 - 7.2.12.1 Recommendation for the Cape Mendocino HU 7-65
 - 7.2.12.2 Mattole River HSA 7-65
 - 7.2.12.3 HSAs with No Recommendations 7-68
- 7.3 CENTRAL CALIFORNIA COAST ESU 7-68
 - 7.3.1 MENDOCINO COAST HYDROLOGIC UNIT 7-68
 - 7.3.1.1 Mendocino Coast HU Recommendations 7-73
 - 7.3.1.2 Albion River HSA 7-75

7.3.1.3	Big River HSA	7-76
7.3.1.4	Garcia River HSA	7-76
7.3.1.5	Navarro River HSA	7-77
7.3.1.6	Noyo River HSA	7-77
7.3.1.7	Ten Mile River HSA	7-78
7.3.1.8	HSAs with No Recommendations	7-78
7.3.2	RUSSIAN RIVER HYDROLOGIC UNIT	7-79
7.3.2.1	Recommendations for the Russian River HU	7-80
7.3.2.2	Russian River Mainstem	7-84
7.3.2.3	Guerneville HSA	7-84
7.3.2.4	Austin Creek HSA	7-85
7.3.2.5	Warm Springs HSA	7-85
7.3.2.6	Mark West Creek HSA	7-86
7.3.2.7	Santa Rosa Creek HSA	7-87
7.3.2.8	Forsythe Creek HSA	7-88
7.3.2.9	Geyserville HSA	7-88
7.3.3	BODEGA AND MARIN COASTAL HYDROLOGIC UNITS	7-89
7.3.3.1	Bodega Marin Coastal HU Recommendations	7-90
7.3.3.2	Salmon Creek HSA	7-93
7.3.3.3	Walker Creek HSA	7-93
7.3.3.4	Lagunitas Creek HSA	7-94
7.3.3.5	Bolinas HSA	7-96
7.3.3.6	HSAs with No Recommendations	7-97
7.3.4	SAN FRANCISCO BAY HYDROLOGIC UNITS	7-97
7.3.4.1	Recommendations for San Francisco Bay HUs	7-98
7.3.4.2	San Rafael HSA.....	7-98
7.3.4.3	HSAs with No Recommendations	7-98
7.3.5	SAN MATEO COAST HYDROLOGIC UNIT	7-101
7.3.5.1	Recommendations for San Mateo Coastal HU	7-102
7.3.5.2	San Gregorio Creek HSA and Pescadero Creek HSA.....	7-105
7.3.5.3	Año Nuevo (Gazos Creek) HSA	7-106
7.3.6	BIG BASIN HYDROLOGIC UNIT	7-106
7.3.6.1	Recommendations for the Big Basin HU	7-110
7.3.6.2	Davenport HSA.....	7-110
7.3.6.3	San Lorenzo River HSA	7-111
7.3.6.4	Aptos-Soquel HSA	7-112

8	Shasta-Scott Pilot Program	8-1
8.1	FRAMEWORK FOR AGRICULTURAL ISSUES	8-1
8.2	SHASTA-SCOTT PILOT PROGRAM RECOMMENDATIONS	8-2
8.2.1	WATER MANAGEMENT RECOMMENDATIONS	8-2
8.2.1.1	Emergency Water Plan	8-3
8.2.1.2	Verification of Water Diversions with Water Rights	8-3
8.2.1.3	Ramped Flows for Diversions	8-4

8.2.1.4	Pulse Flows	8-5
8.2.1.5	Using Unused Water and Water Rights for Instream Fish Flows.....	8-5
8.2.1.6	Irrigation Rotation Program	8-6
8.2.1.7	Install Head Gates and Measuring Devices on Diversions	8-6
8.2.1.8	Water Availability Projections and Forecasts	8-7
8.2.1.9	Instream flow Studies and Recommendations	8-8
8.2.1.10	Groundwater Studies	8-8
8.2.1.11	Water Balance Study	8-9
8.2.2	WATER AUGMENTATION RECOMMENDATIONS.....	8-10
8.2.2.1	Water Trust	8-10
8.2.2.2	Study Additional Large Surface Water Storage	8-11
8.2.2.3	Small Storage Opportunities	8-11
8.2.2.4	Store Water with a Conjunctive Groundwater Use Program and Groundwater Recharge Ponds	8-12
8.2.2.5	Scott Valley Tailings Storage	8-12
8.2.2.6	Water Conveyance to Shasta Valey from Main Klamath	8-13
8.2.2.7	Acquiring Water Rghts	8-13
8.2.3	HABITAT MANAGEMENT RECOMMENDATIONS – SCOTT RIVER.....	8-14
8.2.3.1	Improvement of Summer and Winter Rearing Habitat – Lack of Habitat Complexity.....	8-14
8.2.3.2	Improvement of Summer and Winter Rearing Habitat – High Water Temperatures	8-16
8.2.3.3	Improve Valley and Low-gradient Tributary Channel Structure and Function ...	8-17
8.2.3.4	Barriers to Fish Passage	8-18
8.2.3.5	Improvement of Spawning Habitat	8-18
8.2.4	HABITAT MANAGEMENT RECOMMENDATIONS – SHASTA RIVER.....	8-19
8.2.4.1	Improvement of Rearing Habitat	8-19
8.2.4.2	Barriers to Fish Passage	8-20
8.2.4.3	Spawning Gravel Management	8-21
8.2.4.4	Riparian Vegetation Management	8-23
8.2.4.5	Water Temperature	8-24
8.2.5	WATER USE EFFICIENCY RECOMMENDATIONS.....	8-24
8.2.5.1	Stock Water Alternatives	8-25
8.2.5.2	Landowner Workshops	8-25
8.2.5.3	Ditch Lining and Piping	8-25
8.2.5.4	Ditch Repair and Cleaning	8-26
8.2.5.5	Irrigation System Efficiency	8-26
8.2.5.6	Cropping Changes	8-27
8.2.5.7	Tailwater Reclamation	8-28
8.2.5.8	Agricultural Water Conservation Best Management Practices	8-29
8.2.6	PROTECTION RECOMMENDATIONS.....	8-29

8.2.7	MONITORING AND ASSESSMENT RECOMMENDATIONS	8-32
8.2.7.1	Monitoring and Assessment: Habitat	8-32
8.2.7.2	Monitoring and Assessment: Coho Salmon Populations	8-34
8.2.7.3	Cooperative Efforts	8-35
8.2.7	EDUCATION AND OUTREACH RECOMMENDATIONS	8-36
8.3	ADMINISTRATION AND IMPLEMENTATION.....	8-40
9	Timeframe and Economics of Recovery	9-1
10	Implementation	10-1
10.1	PRIORITIZATION OF WATERSHEDS	10-1
10.1.1	GENERAL PRINCIPLES	10-2
10.1.2	PRIORITIZATION PROCESS.....	10-19
10.1.2.1	Identify Refugia Watersheds and Risk of Extinction	10-19
10.1.2.2	Identify Restoration Potential	10-19
10.1.2.3	Identify Disconnected Habitats	10-20
10.2	IMPLEMENTATION SCHEDULE AND COSTS	10-21
10.3	FEASIBILITY.....	10-21
10.4	AVAILABILITY OF FUNDS	10-21
10.5	RESPONSIBLE PARTIES	10-21
11	Process for Revising the Recovery Strategy	11-1
11.1	TIMETABLE FOR REPORTING AND REVISION	11-1
11.2	TIMETABLE CLARIFYING NON-SPECIFIC LONG-TERM GOALS	11-2
11.3	ADAPTIVE MANAGEMENT	11-3
12	References Cited	12-1